February 2000 Highlights of the Pulsed Power Inertial Confinement Fusion Program

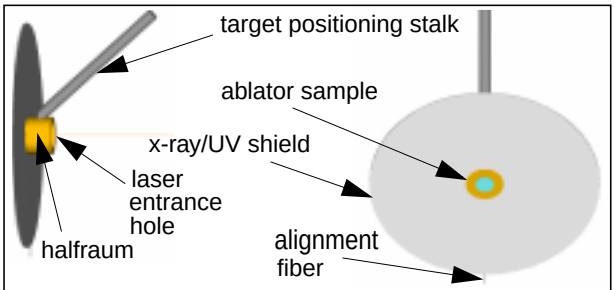

Fig. 1. Target configuration for Omega shots. Two-step ablator samples are 800 μm in diameter. Shield is 1 cm in diameter.

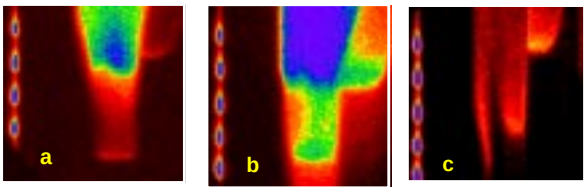

Fig. 2. Shock breakout images from streaked optical pyrometer of two-step samples a) Al (15, 65 μm thick), b) polyimide (30, 80 μm), and c) Cu-doped Be (40, 90 μm). Each fiducial is 550 ps.

We hosted a 4-day Data Exchange Agreement workshop with the French on x-ray technology and a 3-day flux compression workshop that were attended by 13 French nationals. We completed documents that define our future plans and began preparing for a May 17-19 review of our pulsed power programs. Dick Garwin (IBM Watson Lab) is chairing the review panel. The 15 scientists will assess the quality of our science and engineering, the program balance, and our contributions to stockpile stewardship.

The 12 Z shots included a LANL weapon physics shot, a flux compression shot with the French, 3 wire-array shots to compare with earlier shots, 2 nested array shots to assess reproducibility, a second test of new wire-array hardware for the z-pinch-driven hohlraum (ZPDH), a ZPDH shot with a double pinch, and 3 days of short circuit shots to optimize the long-pulse hardware.

To prepare to image radiating plasmas by point projection, beginning in 2001, with Beamlet, a 2-TW prototype of the NIF (see July 98, Feb. 99, and Sept. 99 *Highlights*), a small (12-joule) laser backlighter is being activated during Z operation. On two December tests of the small backlighter during a z-pinch implosion (shots 527 and 528), high-velocity debris clouded the diagnostic film. We are therefore adding baffles and designing a fast closing valve to prevent damage to the x-ray diagnostic. For optimial operation of the former LLNL Beamlet laser, which was renamed Z/Beamlet, the pulse jitter on Z must be reduced; hence, a different laser trigger system (LTS) has been designed for Z. The new LTS is expected to be delivered in June for setup. Implementing the new system, however, will require additional funds for the optics.

On the afternoon of February 22, we did four ICF ablator shock timing experiments at the Omega laser facility. These first SNL-led experiments at Omega were done in collaboration with LANL, LLNL, and the University of Rochester. The experiments were in a “halfraum” (half of a hohlraum) geometry (Fig. 1) that is compatible with the WBS-3 objective of obtaining first-beam-cluster shock-timing measurements on the NIF beginning in FY04. In the Omega experiments, we obtained indirect-drive shock propagation data for aluminum, polyimide, and beryllium doped with 0.9% copper (Fig. 2). The fourth experiment, a disk timing shot, provided a precise time tie for comparison with calculations.

We had a sixth proof-of-principle experiment on Z, with the French, to shorten the x-ray pulse by compressing magnetic flux between two wire arrays (see Dec. 98 *Highlights*). The experiment was designed so that most (~3/4) of the current implodes the outer array; the remaining current, from the lowermost level of the pulse-forming section, together with a 2-Tesla external axial field, provides a seed flux between the two arrays that, when compressed, causes current to increase rapidly in the inner array. The axial magnetic field provides Rayleigh-Taylor stabilization. The technique could significantly reduce the power flow risk and cost of high-current z-pinch drivers. Complementary experiments are being done at CEG in France, and the measured currents are being compared with calculations using the two-dimensional (2-D) particle-in-cell TWOQUICK code and the 2-D radiation-magnetohydrodynamics MACH2 code.

Contact: Keith Matzen, Inertial Confinement Fusion Program, Dept. 1670, 505-845-7756, fax: 505-845-7464, email: mkmatze@sandia.gov
Highlights are prepared by Mary Ann Sweeney, Dept. 1670, 505-845-7307, fax: 505-845-7464, email: masween@sandia.gov.
Archived copies of the *Highlights* beginning July 1993 are available at http://www.sandia.gov/pulspowr/hedicf/highlights.